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AN
EARLY PLEISTOCENE (BLANCAN) FAUNA
FROM NEBRASKA

BY

PAUL O. MCGREW

ASSISTANT CURATOR, PALEONTOLOGY



GEOLOGICAL SERIES
FIELD MUSEUM OF NATURAL HISTORY
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INTRODUCTION

The small but interesting collection of early Pleistocene fossils described in this report has been accumulated by Field Museum over a period of years. On several occasions, Mr. Bryan Patterson, Curator of Paleontology, and Mr. James H. Quinn, Chief Preparator, have stopped at a locality in Brown County, Nebraska, on their trips to and from western Paleocene deposits, and each time they have added a few specimens to the assemblage. I was able to pay a brief visit to the locality in 1940. This fauna is important in that it lies so close to the till border that the deposits in which it occurs were directly affected by the cycles of glaciation, and there is evidence that the mammal-bearing beds were deposited during the Aftonian interglacial period. It may, in addition, be correlated faunally with the Blancan deposits of the West and Southwest and thus offers the first concrete evidence bearing on the exact age of the Blancan faunas.

As an outgrowth of my studies, some observations on the Equidae have given rise to an unusual interpretation of the evidence provided and a rather radical change in our concepts of the history of the family is suggested.

I wish particularly to thank Dr. C. B. Schultz, who permitted me to examine freely the excellent and important collection of mammals from Broadwater in the University of Nebraska State Museum. My colleagues in Field Museum, especially Mr. Bryan Patterson and Mr. Karl P. Schmidt, have aided me with their ever-ready counsel. Dr. Albert A. Dahlberg, Research Associate, aided by making radiographs of a number of specimens. Mr. John Conrad Hansen made the illustrations.

OCCURRENCE OF THE FAUNA

The fossils were found along the steep bank of a dry creek known locally as Sand Draw, sec. 25, T. 31 N., R. 22 W., six miles north of Ainsworth, Brown County, Nebraska. Although exposures of Pleistocene sediments are rather widely distributed in this part of the state, the exposures in Sand Draw that produced the mammal

remains are rather limited, extending approximately 800 yards along the draw. The most complete section at this place is only some 35 feet in thickness and is as follows:

	Feet
1. Top soil.	
2. Cross-bedded sand and gravel	2 1/8
3. Coarse sand and gravel with indurated ferruginous layers at top . . .	8
4. Sand and clay, some mammals	8 1/2
5. Sandy marl containing invertebrates, few mammals	7 1/8
6. Sand and clay, stream-bedded, containing bulk of mammals	10

Lugn (1935) has recently made an important study of Pleistocene deposits west of the till border in Nebraska. He concluded that certain gravels and clays deposited along the ice-front and in pre-Pleistocene valleys may be correlated with glacial and interglacial deposits of the glaciated region. He divided these deposits into the Platte and the Plains series. The former includes the sediments laid down during the Nebraskan, Aftonian, Kansan and Yarmouth ages; the latter includes the remainder of the Pleistocene and Recent deposits. The Platte series is made up of a basal sand and gravel, the Holdredge formation; a sandy clay and silt, the Fullerton formation; another sand and gravel, the Grand Island formation; and, at the top of the series, another sandy clay and silt, the Upland formation. It was Lugn's conclusion that these sediments represent fluvial deposits laid down as "inwash-outwash" in direct correlation with the advance and retreat of the major ice sheets, the sands and gravels representing times of ice advance and the finer sandy clays and silts representing interglacial periods.

If this correlation is substantiated it may lead to a solution of one of the more difficult paleontological problems—the determination of a definite sequence of Pleistocene mammalian faunas.

Along the Niobrara River valley are sediments assigned by Lugn to the Platte series. The Sand Draw fauna comes from an exposure in these beds. Concerning the deposits it is well to quote from this author (1935, p. 193):

"The Pleistocene valley fill at most exposures is made up of a lower, poorly sorted river sand and gravel with much reworked Tertiary material, a silt and clay layer above, and at the top an upper fluvial sand and gravel. The upper sand and gravel formation usually completed the filling of the old valley, and, at many places, was spread out thinly over the terrace or Upland level adjoining the valley itself. A very typical exposure occurs near Long Pine where the lower gravel and sand bed is 40 feet thick and may be the equivalent of or may be the Holdredge (Nebraskan) formation. The over-

lying grayish yellow clay and silt bed is 24 feet thick and may be the Fullerton (Aftonian). The upper sand and gravel unit is exactly like the Grand Island (Kansas) formation, and rests unconformably with a ferruginous contact on the clay below it."

In the Sand Draw section the top gravel in all probability represents the basal portion of the Grand Island formation. The remain-



FIG. 14. Sand Draw, showing section from which fauna was obtained.

ing part of the section probably represents the Fullerton. The ferruginous layers at the top of the sands and clays seem to correspond to those in the general section and may prove to be of importance in local correlation. There is good reason to believe that the entire section at Sand Draw, excluding the top gravel, was deposited during a single interglacial stage. The invertebrates in the marl are such that they could not have lived so close to the ice edge during the cold stage of ice advance.¹ The fossil mammals found both above and below this marl cannot be distinguished and for all purposes of correlation appear to be contemporaneous. The fauna is much more primitive than that of Hay Springs, and, if interglacial, there can be no doubt that it is Aftonian.

¹ Dr. F. C. Baker, letter dated March 29, 1938.

The invertebrates from the marl have been identified by the late Dr. F. C. Baker and are as follows:

Sand Draw exposure:

<i>Pisidium</i> sp.	<i>Menetus kansasensis</i>
<i>Lymnaea</i> cf. <i>stagnalis jugularis</i>	<i>Gyraulus altissimus</i>
<i>Stagnicola</i> sp.	<i>Gastrocopta tappaniana</i>
<i>Fossaria dalli grandis</i>	

The following are from an exposure two miles west of Sand Draw which has exactly the same stratigraphic sequence. A few mammals from this exposure represent species found in Sand Draw. There can be little doubt of the contemporaneity of the deposits in the two localities:

<i>Valvata lewisi helicoidea</i>	<i>Gyraulus umbilicatellus</i>
<i>Stagnicola</i> cf. <i>reflexa</i>	<i>Gyraulus altissimus</i>
<i>Stagnicola caperata</i>	<i>Gyraulus pattersoni</i>
<i>Physa</i> sp.	<i>Gastrocopta cristata</i>
<i>Menetus kansasensis</i>	<i>Vertigo ovata</i>

According to Dr. Baker¹ most of these species occur in all deposits from Aftonian to Wisconsin. The presence of *Menetus kansasensis*, however, leads him to "place the deposit as early Pleistocene, either Aftonian or Yarmouth, and probably Aftonian." *Gyraulus pattersoni* (Baker, 1938) is apparently quite distinct "and may prove another horizon marker." "*Gastrocopta cristata* now lives in Arizona and has never been found north of southern Kansas."

The "*Stegomastodon* quarry" (Osborn, 1936, p. 726), which lies about four miles southeast of Sand Draw, appears from its stratigraphic position and the mammals found therein to be equivalent to the Sand Draw. Although horses from this quarry were referred by Osborn to *Equus giganteus*, I am informed by Dr. C. B. Schultz that the horses from the "*Stegomastodon* quarry" and from Broadwater are identical; the specimens are therefore undoubtedly referable to *Plesippus*. The new species of *Geomys*, described below, occurs at the quarry as well as at Sand Draw.

FAUNAL CORRELATION

Broadwater.—The fauna that is closest to the Sand Draw is unquestionably that from Broadwater, Nebraska, reported by Barbour and Schultz (1937; see also Schultz and Stout, 1941). Unfortunately the large Broadwater fauna has not been described in detail.

¹ Personal communications, March, 1938.

Dr. Schultz, however, generously permitted me to examine those elements of the fauna, particularly the horses, that correspond to elements from Sand Draw. Of twelve mammalian genera thus far known from Sand Draw at least ten are found in the Broadwater, and those species of the two deposits between which comparison is possible agree perfectly. The only genera from Sand Draw that have not yet been found at Broadwater are *Taxidea* and *Trigonictis*. Barbour and Schultz determined the age of the Broadwater as Aftonian on geological observations that have not yet been published. The extremely close faunal similarity, in addition to the geological evidence, should permit confident acceptance of the essential contemporaneity of the two faunas.

Rexroad.—If the Sand Draw and Broadwater faunas are compared with that of the Rexroad of Kansas (Hibbard, 1938, 1941a, 1941b), extremely close agreement may be noted. They have seventeen genera in common. Hibbard has described as new a number of genera, some of which are at least very close to Broadwater forms. When closer comparisons are made several more genera will probably be found to be common to the two faunas. The differences that do exist may readily be accounted for by accidents of preservation.

Frye and Hibbard (1941) have described in some detail the stratigraphic relationships of the Rexroad deposits in the Meade basin of Kansas. It was their conclusion that the Rexroad should be included in the Ogallala formation as late Pliocene. The following reasons were given: (1) In some parts of the Meade basin there was continuous sedimentation from middle Pliocene through late Pliocene time and in these localities no break is distinguishable. (2) The deposits were trapped in a local basin, and, although there are deposits of equivalent age outside this general area, they are not stratigraphically continuous with the deposits of the Rexroad type locality and are not genetically related to them. (3) The lithology of the Rexroad beds for the most part is indistinguishable from the middle Pliocene part of the Ogallala formation.

According to Frye and Hibbard, major faulting began in the Meade basin after deposition of the so-called middle Pliocene portion of the Ogallala. Later, the resulting structural depressions were deepened, and it was in these that the Rexroad sediments were deposited. Also, at the beginning of Rexroad times, sink holes began to develop. Both faulting and the development of sink holes continued well into later, definitely Pleistocene time.

Geologically, there seems to be little reason to assign the Rexroad to the late Pliocene. Some rather significant geologic changes—the faulting, the development of sink holes, and erosion—took place between the Pliocene beds beneath and the Rexroad proper. It seems that the correlation of the fossiliferous beds with the upper part of the Ogallala might be in some doubt. The Rexroad deposit, being reworked Ogallala, would surely be lithologically similar. All that can really be said concerning the age of the Rexroad from the geological viewpoint is that it lies between true Pliocene below and definitely assignable Pleistocene above.

Determination of the age of the Rexroad depends on other beds whose age can be determined and with which the Rexroad may be correlated faunally. Thus, if, as in this case, equivalent faunas are found to be Pleistocene there can be little doubt as to the age of the Rexroad.

Blancan.—If the genera of all so-called late Pliocene, or Blancan, faunas are considered, it is possible to define that provincial age rather sharply. All have definite characters in common and mammalian associations that appear to be restricted to this group of faunas. Most of these have been pointed out by Wilson (1938) and J. R. Schultz (1938). The assemblages that are regarded as definitely Blancan include the Blanco, Hagerman, Coso Mountain, and Benson. The Blancan may be defined faunally by the following characters:

(1) Conspicuous absence of such typically Pliocene mammals as *Aphelops*, *Teleoceras*, *Pliohippus*, *Neohipparion*, *Mylagaulus*, *Osteoborus*, *Metoreodon*, *Sphenophalus*, *Merycodus*, *Machairodus*, *Liodontia*, *Prosthennops*, and *Dipoides*.

(2) Presence of many characteristically middle and late Pleistocene genera among which may be especially noted *Camelops*, *Platygonus*, *Stegomastodon*, *Felis*, *Capromeryx*, *Aenocyon*, *Eligmodontia*, *Onychomys*, *Sigmodon*, *Neotoma*, and *Ondatra*.

(3) Presence of certain genera that survived from the Hemphillian but did not outlive the Blancan. The most important of these are *Nannippus* and some primitive proboscideans such as *Serbelodon* and *Rhynchotherium*.

(4) Presence of certain genera limited to the Blancan, such as *Plesippus*, *Borophagus*, *Mimomys*, and *Procastoroides*.

(5) Absence of certain genera that made their first appearance after the close of the Blancan: *Archidiskodon*, *Mammonteus*, *Parelephas*, *Bison*, *Castoroides*, and *Equus* ss.

COMPARISON OF SAND DRAW AND BROADWATER WITH
REXRoad AND BLANCO FAUNAS

	Sand Draw	Broad- water		Sand Draw Broad- water	Rex- road		Sand Draw Broad- water	Blan- co
Canis.....	—	—	Sorex.....	—	—	Borophagus.....	—	—
Smilodon.....	—	—	Canis.....	—	—	Canis.....	—	—
Procastoroides.....	—	—	Taxidea.....	—	—	Paramylodon.....	—	—
Geomys.....	—	—	Trigonictis.....	—	—	Megalonyx.....	—	—
Stegomastodon.....	—	—	Hypolagus.....	—	—	Felis.....	—	—
Plesippus.....	—	—	Citellus.....	—	—	Stegomastodon.....	—	—
Platygonus.....	—	—	Geomys.....	—	—	Plesippus.....	—	—
Camelops.....	—	—	Procastoroides.....	—	—	Nannippus.....	—	—
Gigantocamelus.....	—	—	Peromyscus.....	—	—	Platygonus.....	—	—
Capromeryx.....	—	—	Phenacomys.....	—	—	Camelops.....	—	—
Trigonictis.....	—	—	Pliopotamys.....	—	—	Gigantocamelus.....	—	—
Taxidea.....	—	—	Plesippus.....	—	—	Serbelodon.....	—	—
Sorex.....	—	—	Nannippus.....	—	—	Rhyncotherium.....	—	—
Paramylodon.....	—	—	Platygonus.....	—	—	Cordillerion.....	—	—
Megalonyx.....	—	—	Camelops.....	—	—	Canimartes.....	—	—
Borophagus.....	—	—	Tanupolama.....	—	—	Glyptotherium.....	—	—
Lutra (Satherium).....	—	—	Capromeryx.....	—	—	Sorex.....	—	—
Mephitis.....	—	—	Paramylodon.....	—	—	Lutra (Satherium).....	—	—
Hypolagus.....	—	—	Megalonyx.....	—	—	Mephitis.....	—	—
Sylvilagus.....	—	—	Borophagus.....	—	—	Smilodon.....	—	—
Citellus(?).....	—	—	Lutra (Satherium).....	—	—	Hypolagus.....	—	—
Cynomys(?).....	—	—	Mephitis.....	—	—	Sylvilagus.....	—	—
Thomomys.....	—	—	Smilodon.....	—	—	Citellus.....	—	—
Peromyscus.....	—	—	Sylvilagus.....	—	—	Cynomys.....	—	—
Pliopotamys.....	—	—	Cynomys(?).....	—	—	Geomys.....	—	—
Phenacomys.....	—	—	Thomomys.....	—	—	Thomomys.....	—	—
Neotoma(?).....	—	—	Neotoma.....	—	—	Procastoroides.....	—	—
Nannippus.....	—	—	Stegomastodon.....	—	—	Peromyscus.....	—	—
Tanupolama.....	—	—	Gigantocamelus.....	—	—	Pliopotamys.....	—	—
			Blarina.....	—	—	Phenacomys.....	—	—
			Hesperoscalops.....	—	—	Neotoma.....	—	—
			Scalopus.....	—	—	Tanupolama.....	—	—
			Procyon.....	—	—	Capromeryx.....	—	—
			Brachyprotoma.....	—	—			
			Spilogale.....	—	—			
			Felis.....	—	—			
			Liomys.....	—	—			
			Perognathus.....	—	—			
			Onychomys.....	—	—			
			Baiomys.....	—	—			
			Eligmodontia.....	—	—			
			Symmetrodontomys.....	—	—			
			Sigmodon.....	—	—			
			Parahodomys.....	—	—			
			Pliolemmus.....	—	—			
			Ogmodontomys.....	—	—			

— Denotes presence

The limited geographic range of some of the genera listed above offers certain complications. This is true primarily of those genera that survived the Hemphillian and were on the verge of extinction. *Nannippus*, for example, is very abundant in the Southwest. It is well known in the Rexroad of southern Kansas. In southern Nebraska, at Broadwater, it is represented only by a single metapodial and in northern Nebraska, at Sand Draw, the genus has not as yet been found. Because *Nannippus*, along with other horses, usually is abundantly preserved in localities where it is known to have existed, it is highly probable that Broadwater was at or near the limit of its northern range. That *Nannippus* lived longer in the Southwest than it did in the far west is adequately proved by its absence from such faunas as Coso Mountain, San Joaquin, and Hagerman.

It is also very probable that certain of the primitive proboscideans known from the Blanco did not range as far northward as Broadwater or Sand Draw, but the late Tertiary and early Pleistocene history of the proboscideans is insufficiently known.

If the Blancan may be defined in the manner indicated above there can be no doubt that the Sand Draw and Broadwater faunas fit into this age unit. The presence of *Plesippus*, *Mimomys*, and *Borophagus* and the association of *Nannippus* with *Platygonus*, *Camelops*, and *Tanupolama* is sufficient evidence.

The most conspicuous difference between the Sand Draw-Broadwater faunas and the Blanco, but undoubtedly the least significant, is the absence of rodents and smaller mammals in the latter. Certainly this is due to local conditions of deposition and not to any lack of those forms in Texas during Blancan times. If Blanco rodents were known the faunas would almost certainly show even greater similarity. As indicated above, other differences between the two faunas may be accounted for by their geographic separation.

These differences might be interpreted, as they have in some cases, as meaning that the Blanco is older, that the primitive proboscideans became extinct simultaneously all over North America, and that the Texas fauna lived before the extinction and the Nebraska fauna after. Simpson (1931) has shown that this approach is not always justified. Especially would this be true during a time of sharp climatic zoning such as the Pleistocene. An additional important factor is that the particular mammals in question were on the verge of extinction. We should expect the final ranges of such forms to be greatly restricted.

If, then, the Sand Draw and Broadwater faunas can be correlated with the early Pleistocene deposits of the glaciated region and can be shown to be Blancan in age there is no alternative but to regard the Blancan as Pleistocene. This change has been ably advocated by Wilson and by J. R. Schultz, who have shown that the Blancan faunas have much closer affinities with Pleistocene than with Pliocene faunas and also that a great faunal break exists between the Hemphillian and the Blancan. These authors cite considerable evidence of general cooling that at least foreshadowed actual glaciation. This evidence, combined with the probability of a definite Aftonian age of the Sand Draw and Broadwater faunas, is so strong as to seem conclusive.

Allocation of the Blancan to the Pliocene has rested on rather insecure evidence. The Blanco fauna was originally assigned to the Pliocene because it was definitely earlier than the Rock Creek which was believed to be early Pleistocene and later than the "Loup Fork" or early Pliocene. Subsequently, the Blancan has served as a datum point by which other faunas were assigned to Pliocene or Pleistocene. Any fauna that bore resemblances to the Blanco was automatically placed in the late Pliocene, usually without question or further reason. Practically the only faunal evidence for the Pliocene age of the Blancan is that stated by Gazin (1936) in discussing the age of the Hagerman:

"The Mammalia found at Hagerman appear to be in an advanced Pliocene stage both in development of several of the forms represented and in the composition of the fauna. Most noticeable is the absence of forms typically Pleistocene in age, as mylodont sloths, mammoths, *Mastodon americanus*, true *Equus*, bison, musk-ox, *Ursus*, *Castoroides*, and *Lepus*. Most of these are recognized in early Pleistocene, possibly Aftonian, as indicated by Calvin's work, or Yarmouth, according to Lugin and Schultz. Moreover, several of the forms present as *Hyaenognathus* or *Borophagus*, *Lutravus*(?), *Plesippus*, mastodont, *Mimomys*, and the rabbits show Pliocene affinities, many of the remaining genera as recognized being less restricted in time."

This evidence is far overbalanced by the entire faunal picture as revealed by J. R. Schultz, by Wilson, and by Barbour and C. B. Schultz, and for practical purposes is completely disqualified by the evidence afforded by the Sand Draw and Broadwater occurrences. If the Blancan is placed in the early Pleistocene, the division between that epoch and the Pliocene may be sharply drawn (see

faunal definition of the Blancan, and below). Likewise, because of certain extinctions (*Nannippus*, *Mimomys*, *Borophagus* and some proboscidiens) before the Hay Springs and the appearance of new immigrant forms in the Hay Springs there is adequate faunal distinction between the Blancan early Pleistocene and what might be termed middle Pleistocene, beginning with the Kansan or Yarmouth.

Previous studies of Pleistocene mammals have shown that it is extremely difficult if not impossible at the present time to distinguish faunally between middle and late Pleistocene in North America. C. B. Schultz (1934) recorded *Bison*, *Symbos*, and *Mammonteus* from deposits of Kansan age. If this age assignment is correct it is difficult to understand why some of these forms have not been found at Hay Springs. If these genera could be shown to be of post-Yarmouth arrival they would make an excellent marker for faunal division of later Pleistocene time.

Some genera appear to have arrived in North America in the late Pleistocene—*Holmesina*, *Boreostracon*, *Tatu*, *Hydrochoerus*, and *Neochoerus*. These genera, all of South American origin, had very restricted geographic ranges in North America and at present are of little broad significance. In addition there is a good possibility that their absence in the middle Pleistocene is only apparent because fossil deposits of that age may not be known within the limited ranges of these mammals.

As collections grow, and when standard statistical methods come into general use, it will probably be possible to determine in some detail successive faunal zones within the Pleistocene. At present, when hardly any two workers have the same opinions concerning the structural limits of a species, it is futile to attempt correlation on the basis of reported mammalian species.

The chart on page 43 shows the ranges of the most important Pleistocene genera in North America.

CORRELATION WITH OLD WORLD FAUNAS

Nearly all American and some European paleontologists have used the Equidae as a basis for correlation of the late Pliocene-early Pleistocene faunas of America and Eurasia. The perfectly logical reasoning has been (1) that *Equus* originated in North America, and (2) that those deposits in which the genus first appeared in the Old World are necessarily as recent as those in which it first appeared in the New World.

RANGES OF CERTAIN PLEISTOCENE GENERA IN NORTH AMERICA

		Blancan	Mid-Pleist.	Late Pleist.	Recent
IMMIGRANT GENERA	Of probable Old World origin	Onychomys Sigmodon Neotoma Synaptomys Ondatra	— ... — ... —	... ... ... ... ...	... ... ... ... ...
	Of South American origin	Erethizon Glyptodonts Paramylodon Megatherium	— ... — ...	... ... ... ...	... ... ... ...
	Of Old World origin	Mimomys Stegomastodon Equus Archidiskodon Parelephas Mammonteus Cervalces Symbos Bison	— — ... — — — — — —	... ... ... ... ... ... ... ... ...	... ... ... ... ... ... ... ... ...
	Of South American origin (range limited)	Nothrotherium Holmesina Boreostracon Tatu Hydrochoerus Neochoerus	? ? ? ? ? ?	— — — — — —	... ... ... ... ... ...
	Last appearance of Hemphillian survivors	Nannippus Rhynchotherium Serbelodon	... ... ...		
AUTOCHTHONOUS GENERA	Limited to Blancan	Borophagus Procastoroides Hippotigris	— — —		
	New genera derived from autochthonous stocks	Lutra Aenocyon Felis Smilodon Platygonus Camelops Tanupolama Capromeryx	— ... — ... — ... — ... —	... ... ... ... ... ... ... ... ...	... ... ... ... ... ... ... ... ...
	Long-range genera	Mustela Martes Megalonyx Hypolagus Castor Perognathus Thomomys Geomys Peromyscus Citellus Tapirus	... ... ... ... ... ... ... ... ... ... ...	... ... ... ... ... ... ... ... ... ... ...	... ... ... ... ... ... ... ... ... ... ...

— First appearance

... Range

The first occurrences of *Equus* ss. in the Old World are in the Villafranchian of Europe, the Nihowan of China, and the Tatrot of India. The Tatrot specimen (Lewis, 1937) has not been described, but the presence there of a modernized horse that even might be true *Equus* is most significant. In North America the earliest definite record of *Equus* is in the Hay Springs (see below). Considering this line of evidence alone, the Hay Springs fauna has been correlated with the Villafranchian, Pinjor, and Tatrot (Colbert, 1935; Lewis, 1937).

Because of the primitive condition of Villafranchian mammals in general, Pilgrim (1938, 1940) regards that time unit as earlier than Hay Springs. Colbert (1935) concedes that if it were not for the Equidae the evidence would be greatly in favor of Pilgrim's views of correlation, but concludes that in this case the evidence of *Equus* should be given weight over the evidence of an entire fauna. A similar problem exists concerning the age of the Tatrot, since Lewis correlates those deposits with the Rock Creek because of the occurrence of *Equus*. I cannot presume to enter into this discussion with any first-hand knowledge of the European and Asiatic mammals in general, but I am involved in it because the origin of *Equus* bears so directly on the broad correlation of the Sand Draw fauna.

The late Pliocene and Pleistocene horses of North America have been described for the most part without regard to various Old World extinct and living wild horses. This despite the fact that the Old World horses, migrating as they did from America at a relatively recent date, must bear close relationships with those of North America. The few craniometric comparisons that have been made help but little in this respect.

Blancan horses were separated from *Equus* by Matthew (1924) as *Plesippus*. J. R. Schultz (1936, 1938) observed that the similarity between *Plesippus* and *Equus stenonis* was so close that the two must be closely related and suggested that the Old World form be regarded as a species of the New World genus. Although this conclusion has not yet come into general acceptance the practical identity of the two, and their distinctness from the caballine horses, cannot be doubted. Both have relatively short protocones, round metaconids and metastylids separated by V-shaped valleys, strong hypostylids on DM₃, and generally strong parastylids on the milk teeth. Thus, whatever is true of the relationships of *Equus stenonis* must also be considered true for the genus *Plesippus*.

Equus stenonis of the European Villafranchian has long been recognized as a member of the zebrine group (see Boule, 1900). This relationship is proved by the presence in the extinct species of all those dental characters distinguishing the zebras.

In Villafranchian deposits of Europe and Asia both caballine and zebrine horses occur and are as distinctly separated structurally as are the horses and zebras of today. It is quite certain then that the caballine horses (*Equus* ss.) acquired their distinguishing characters before Villafranchian time.

In North America well-defined *Plesippus* abounded throughout the Blancan and there is no acceptable record of a true *Equus* existing during this time.¹ The earliest known fauna in America subsequent to the Blancan, the Hay Springs, contains an abundance of well-defined *Equus* but no *Plesippus*. This very sudden appearance of *Equus* ss. brings up a question concerning its ancestry. Although I have not been able to examine as many milk teeth of *Pliohippus* as I should like, those I have seen indicate that the development of a strong hypostylid on DM₃ is a progressive character in *Plesippus* and the zebras. It is present in *Pliohippus* but only at the base of the tooth. If this character is supported by further specimens of *Pliohippus*, we may conclude that in this respect *Equus* is more primitive than *Plesippus*, and draw the still more important inference that the two forms belonged to different lines of descent so that the one cannot possibly be ancestral to the other. This conclusion has considerable supporting evidence. The early appearance in Europe of both caballine and zebrine horses led Hopwood (1936) to conclude that they evolved independently. Strong support also is found in the subgenus *Astrohippus*, which Stirton (1940) believes to be ancestral to *Equus*. The figures I have seen of the milk teeth of this form do not show the strong hypostylid on DM₃, and the permanent teeth approach those of *Equus* more closely than they do those of *Plesippus*. The protocone of the Hemphillian genus is more elongate than in many specimens of *Plesippus*. The metaconids and metastylids of the lower teeth tend to be U-shaped as in *Equus*, and not V-shaped as in *Plesippus*. In other words, there seems to be excellent evidence that *Astrohippus* gave rise to *Equus* while *Pliohippus* ss. was ancestral to *Plesippus* and the zebras.

¹ Barbour and Schultz (1937) originally referred the Broadwater horses to a species near *Equus excelsus* and to a more primitive species. In 1941, however, Schultz and Stout referred to them as *Equus* (near *Plesippus*) sp. Because of the zebrine characters of the Broadwater specimens they cannot represent true *Equus*.

The last appearance of *Astrohippus* is in the Hemphillian and the first appearance of *Equus* in North America is in the much later Hay Springs. If *Astrohippus* was ancestral to *Equus* the transition presumably took place elsewhere than in North America. The presence in Europe and Asia of true *Equus* in beds that, according to the usual rules of correlation, are earlier than the Hay Springs would strongly indicate a center of origin nearer to those regions than to North America. Some evidence as to the place of origin is afforded by the *Equus* in the Tatrot of northern India, which deposits both Pilgrim (1940) and Colbert (1935) regard as earlier than Villafranchian. It seems entirely in accord with the evidence to postulate that *Astrohippus* migrated to Asia toward the close of Hemphillian time and there gave rise to *Equus*. The only Asiatic fauna that might represent the time gap between the Hemphillian and Blancan and between the Dhok Pathan and Pinjor is the Tatrot,¹ and it is very possible that the Tatrot *Equus* represents a transitional stage between *Astrohippus* and *Equus*. *Plesippus* certainly made its way to Asia and Europe shortly after Hemphillian time, as is shown by its presence in the Villafranchian and Pinjor. In North America the *Plesippus* group must have become extinct along with such mammals as *Borophagus*, *Nannippus*, and certain proboscidiens at the close of the Blancan. If *Equus* originated in Asia in this manner its appearance in Europe earlier than in America should be expected. When *Archidiskodon*, *Mammonteus*, *Parelephas*, *Bison*, *Symbos*, and *Cervalces* spread to North America after the close of the Blancan, they were accompanied by *Equus*, which by that time had become well established in Asia. This was suggested as a possibility by Hay (1925).

The so-called "*Equus*" *stenonis* is referable to the group containing the modern zebras. It is now evident that *Plesippus* must be referred to this group as well, and that the prior generic name *Hippotigris* (for the zebras) is zoologically correct for the American form (see further discussion on pp. 56-63).

Bryan Patterson has suggested to me another line of evidence that to some extent confirms the above conclusions. The early Pleistocene Ensenadan of South America contains no *Equus*, but only those horses (*Hippidium*, *Onohippidium*, etc.) that were derived

¹ In a recent paper, T. T. Paterson (1942) placed the Tatrot in the basal Pleistocene (=Nebraskan) and the Pinjor (=Villafranchian) in the Aftonian. His conclusions were based upon the probable contemporaneity of wide-spread but similar changes in sedimentation resulting from combined orogenic and precipitational changes effected by the glacial cycles.

from a more primitive northern stock. In South America *Equus* did not appear until the middle Pleistocene (Belgrano, Tarija). If the genus was indigenous to North America and was present during the early Pleistocene it should have reached South America at that time, along with many other northern mammals.

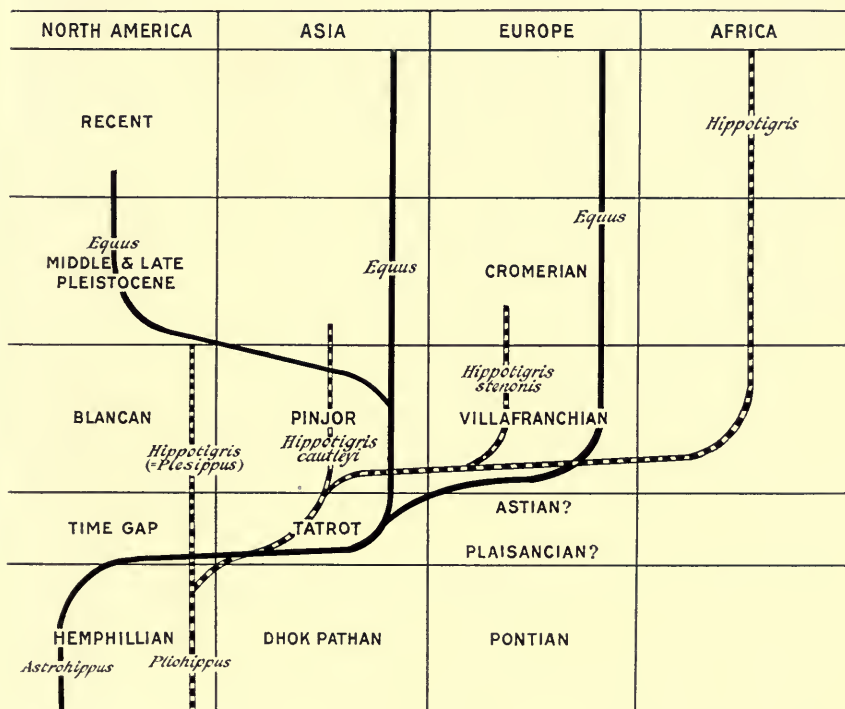


FIG. 15. Evolution and distribution of Pliocene-Pleistocene horses as interpreted in this paper.

The strong possibility that the history of the Equidae has not been fully understood, and that it may have been as suggested herein, makes Pilgrim's correlation of European, Asiatic, and American faunas much more in keeping with all evidence.

Although far from complete, the geological evidence is much more in favor of correlation between the Villafranchian and Blancan than between the Villafranchian and Hay Springs. The European deposits are believed by most geologists and by at least some paleontologists to be pre-glacial; even by those who accept the Pleistocene age of these deposits. Some, however (Moir, 1932),

believe certain erratics under the English Crag series to represent material deposited during the first glacial advance. Whatever may eventually prove to be true, the fact remains that there is little possibility that the Norwich Crag (and thus Villafranchian) can be later than the first interglacial; there is some possibility that it is earlier. If the Hay Springs is Yarmouth (second interglacial), correlation with the Villafranchian can hardly be justified.

Charts like the one shown in figure 15 are probably too common and seem to presume definite knowledge that does not exist. They do, however, present the clearest summary of conclusions. This chart shows the possible interpretation of the evidence presented above.

DESCRIPTION OF FAUNA

Class Pisces

Family Ameiuridae

Referred specimens.—F.M. Nos. P26954 a-d, four pectoral spines.

Discussion.—The four pectoral spines are certainly referable to the Ameiuridae and probably to *Ameiurus*. The specimens are being studied in detail by Mr. Loren P. Woods, Assistant Curator of Fishes.

Class Reptilia

Order Testudinata

Family Emydidae

Pseudemys sp.

Referred specimen.—F.M. No. P26957, anterior portion of plastron, including right and left epiplastra and entoplastron.

Discussion.—*Trachemys* and *Pseudemys* have been separated on minor skull differences. The former, however, is usually regarded as a synonym of the latter. There are no shell differences to separate the forms. The specimen from Sand Draw is clearly referable to this genus but is not sufficiently complete to determine specific affinities.

Family Testudinidae

Testudo spp.

Referred specimens.—F.M. No. P15761, a pygal; and F.M. No. P26181, a portion of a carapace with the eighth to the eleventh peripherals of the right side.

Discussion.—The series of peripherals (P26181) represents a turtle that was between 80 and 85 cm. in length. It seems to have no characters that distinguish it from other Pliocene and Pleistocene species and none that permit certain specific determination. Specimens from the Blanco (*T. campester*) approach the Sand Draw form in size.

The pygal (P15761) is of special interest because it represents an enormous *Testudo* which, if the size of the pygal is any guide, must have been at least two meters in length. The greatest width of the pygal is 117.4 mm. and the greatest length 129.4 mm. There are some indications that the specimen may belong to a species distinct from that represented by the series of peripherals. The sutural surface for the contact of the pygal and eleventh peripheral is quite different in the two specimens. In the smaller one the lower portion of the suture is strongly convex laterally while in the larger it is nearly straight. Also the border of the carapace in the smaller individual flares outward considerably more than that of the larger.

Class Mammalia

Order Rodentia

Family Geomyidae

*Geomys quinni*¹ sp. nov.

Holotype.—F.M. No. P27011, a skull with complete dentition but lacking posterior part of brain case and occiput. Associated left mandible complete.

Paratypes.—Lower jaws F.M. Nos. P27012–14, P26175, P25290–93, P25299, P25300.

Locality and horizon.—Sand Draw, six miles north of Ainsworth, Nebraska; Blancan.

Diagnosis.—Differs from all other known species in the greater narrowness of the muzzle immediately anterior to the zygoma. Size about that of *Geomys tuza*.

Discussion.—Eight specimens of each living species were used as a basis of comparison with the fossil. Ratio diagrams (following Simpson, 1941) were made, seven characters which were measurable in the fossil being chosen for this ratio comparison. A summary of the results is shown in figure 17.²

¹ For James H. Quinn, who discovered the Sand Draw locality.

² The original data have been placed on permanent file in the Division of Paleontology, Field Museum.

The several lower jaws from Sand Draw display considerable variation but probably not more than exists between extreme members of a living species of the genus.



FIG. 16. *Geomys quinni* sp. nov. F.M. No. P27011. Type. $\times 2$. Ventral view of skull; dorsal and lateral views of left mandible.

The few extinct species of *Geomys* that have been described all appear to be valid. *G. parvidens* has a notably shorter cheektooth series and the angular process is not so distant from the condyle as in other species. *G. persimilis* is much the smallest of all species.

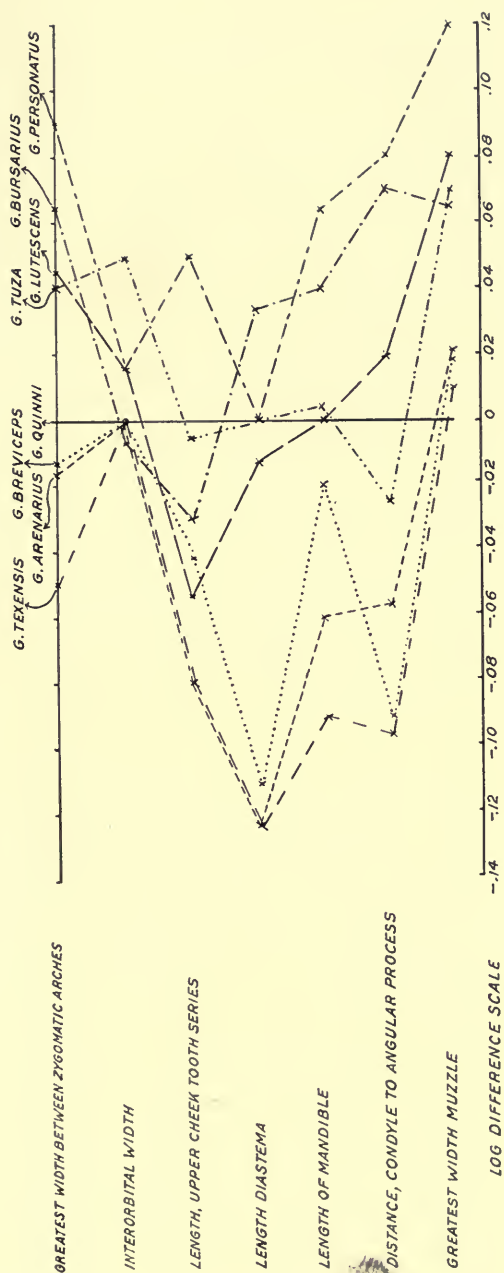


FIG. 17. Ratio diagram of mean values of skull and jaw dimensions in various species of *Geomys*. Eight specimens of each living species were used to obtain the means.

G. minor is unique in the absence of the deep pit between the coronoid process and last molars for the insertion of the temporalis muscle (Gidley, 1922).

COMPARISON OF *GEOMYS QUINNI* WITH VARIOUS OTHER SPECIES OF *GEOMYS*

	<i>breviceps</i> <i>texensis</i> <i>arenarius</i>	<i>bursarius</i> <i>lutescens</i>	<i>tuza</i>	<i>personatus</i>
Zygomatic breadth	+	—	—	—
Interorbital breadth	=	=	—	=
Length of cheektooth series	+	+	=	—
Diastema	+	=	=	=
Length of mandible	+	=	=	—
Distance from condyle to base of angular process	+	=	=	—
Breadth of muzzle in front of zygoma	—	—	—	—

=, —, + signs signify that the character in *G. quinni* is equal to, less, or greater than the same character in the species indicated.

The characters of *Geomys quinni* do not suggest close relationship with any of the described species.

MEASUREMENTS OF TYPE

(In millimeters)

Greatest distance between zygomatic arches.....	27.5
Interorbital breadth.....	6.5
Upper cheektooth series.....	9.5
Anterior border of P ⁴ to posterior alveolar border of incisor.....	18.5
Breadth of muzzle at narrowest point.....	8.5
Posterior extremity of condyle to posterior alveolar border of lower incisor..	31.5
Anterior border of P ₄ to posterior alveolar border of incisor.....	9.9

Family Castoridae

Procastoroides sweeti Barbour and Schultz

Eocastoroides lanei Hibbard, Trans. Kans. Acad. Sci., 40, pp. 244–246.

Referred specimens.—F.M. No. P26165, right maxillary with P⁴–M², three vertebrae and the distal end of a humerus. P14974, partial right mandible with P₄–M₃.

Discussion.—Specimens of this interesting genus were described almost simultaneously from the Rexroad of Kansas (Hibbard, 1938) and from the Broadwater of southern Nebraska (Barbour and

Schultz, 1937). The genus appears to be approximately intermediate between *Dipoides* and *Castoroides*, bearing out the supposed relationships of those genera.

The specimens from Sand Draw do not differ from those of *Procastoroides sweeti* and I cannot add to the description of the form given by the above-mentioned authors. If the position of the genus between *Dipoides* and *Castoroides* is correctly determined there was extremely rapid evolution in this particular line, and its members, when better known, will probably prove to be especially valuable index fossils.

Order Carnivora

Family Canidae

Canis cf. *latrans* Say

Referred specimens.—F.M. No. P15511, a right P⁴; F.M. No. P26958, a left P⁴.

Discussion.—The two carnassials agree so perfectly that they may represent a single individual. They are indistinguishable from the corresponding teeth of *C. latrans*.

Family Mustelidae

Trigonictis kansasensis Hibbard

Referred specimen.—F.M. No. P25294, portion of left maxillary with M¹.

Discussion.—*Trigonictis* was described by Hibbard (1941b) on good upper and lower dentitions from Rexroad. Agreement of the Sand Draw specimen with that from Rexroad is perfect and there can be no doubt as to their identity. Because of striking differences in the upper carnassial there is little possibility that this form represents *Canimartes* as Hibbard points out. Furthermore, if Cope's figures are even approximately correct, the first molars are quite distinct in the two forms. M¹ is extremely close to that of certain otters, and, despite important differences in the carnassial, I suspect that *Trigonictis* will prove to be an aberrant member of that group. The fact that the genus is known only from the equivalent deposits of Sand Draw and Rexroad indicates that it may prove to be an important horizon marker.

Taxidea cf. *taxus*

Referred specimen.—F.M. No. P26946, right mandible with P₃, M₁₋₂.

Discussion.—The talonid of M_1 in the Sand Draw specimen seems to differ from typical specimens of *Taxidea taxus* in the extreme development of its cusps.

This talonid consists of five cusps arranged in two transverse rows, three in front and two behind. Because in most specimens of



FIG. 18. *Taxidea* cf. *taxus*. F.M. No. P26946. $\times 1$. Medial, dorsal, and ventral views of right mandible.

Taxidea taxus the cusp corresponding to the central cusp of the front row in the fossil appears uniformly well developed, I believe it to represent the hypoconid. The external cusp of this row, then, is accessory, and the internal cusp is the entoconid. The hypoconid is but slightly higher than the other two. Of the two posterior cusps the external one, which lies immediately behind the hypoconid, is the stronger and appears to be the hypoconulid. The internal one,

distinct but not widely separated from the hypoconulid, is an accessory cusp.

Hall (1936) has pointed out that there is considerable variation in the relative development of the talonid cusps among living individuals. Some have cusps corresponding to all of those in the Sand Draw specimen. Even though no specimens I have seen approach the extreme development of these cusps in the fossil the high variation in living specimens leads me to refer the specimen tentatively to *T. taxus*, at least until more specimens from the same population are available.

M₂ is like that of the existing species in crown features. It is, however, somewhat larger than in any specimen in Field Museum collections.

Family Felidae

Smilodon sp.

Referred specimen.—F.M. No. P26164, a femur lacking the distal end.

Discussion.—The femur from Sand Draw differs from that of *Smilodon californicus* in having a straighter, longer, and more slender shaft and in having a deeper notch between the great trochanter and head. In the character of the shaft the specimen resembles more closely the femur of *Panthera atrox* than known specimens of *Smilodon*, but the features of its proximal end are those that characterize *Smilodon* and distinguish it from *Panthera*. Because of these differences it is hardly likely that the femur can belong to *Smilodon californicus*.

Order Proboscidea

Family Humboldtidae

Stegomastodon primitivus Osborn

Referred specimen.—F.M. No. P15513, metacarpal III.

Discussion.—Additional specimens of *Stegomastodon*, including jaws and teeth, were collected from Sand Draw by Mr. Quinn before he became affiliated with Field Museum. These are now in the Frick collection.

Order Perissodactyla

Family Equidae

Hippotigris Gray

Hippotigris simplicidens (Cope)

Plesippus simplicidens Matthew, Amer. Mus. Nov., No. 131, pp. 1-2, 1924.

Referred specimens.—F.M. No. P14973, partial skull with basi-cranium and complete cheektooth series; P14976, left maxillary with P²–M³; P15515, ungual phalanx; P27020, femur; P15502, metatarsal; P15505 and P15514, metacarpals; P26173, distal end of humerus; P15760, astragalus; P15512, distal end of tibia; P15516, navicular; P14972, DM₂₋₃; P26163, left mandible with symphysis and dentition.

Discussion.—The dentition of the horse from Sand Draw is distinctly of the "*Plesippus*" type. The metaconids-metastylids of the lower cheekteeth are round and are separated by sharp, V-shaped grooves. DM₃ has a strong hypostylid and all of the milk teeth have relatively strong parastylids.

Dr. C. B. Schultz permitted me to compare the Sand Draw specimens in detail with those from Broadwater and there is little doubt that the horses from the two localities are of the same species and are not true *Equus*.

J. R. Schultz (1936, 1938) pointed out that "*Plesippus*" and "*Equus*" *stenonis* are so similar that they must be closely related. Of this fact there can be no doubt. The relationship between "*Equus*" *stenonis* and the living zebras has also been discussed by several authors (see particularly Boule, 1900). If these affinities are recognized we are led to the conclusion that "*Plesippus*" is more closely related to the zebras than to horses of the caballine group. In view of this possible relationship I have found it desirable to review those dental characters that have been used by Owen (1869), Major (1877–80), Boule (1900), von Reichenau (1915), van Hoepen (1932), Hopwood (1936), and others to separate the various living equids on the basis of their dentition.

The attempt to tie characters into the proper group has been rather complicated because of disagreement among neomammalogists on a correct taxonomic arrangement of the living forms. Four groups are usually recognized: zebras, African asses, Asiatic half-asses and caballines. Grevy's zebra has been distinguished by some taxonomists as a fifth group (Pocock, 1902; Heller, 1912). Lydekker (1901) recognized but two major groups, the zebras and African asses in one and the Asiatic half-asses and caballines in the other. There is little doubt that the zebras and African asses are distinct from each other and from the caballines. The systematic position of Asiatic wild horses, except, perhaps, *Equus przewalskii*, is more open to question however, and it is debatable into which major group they best fit. This refers especially to the Onanger, Kiang, Hemippus, etc.

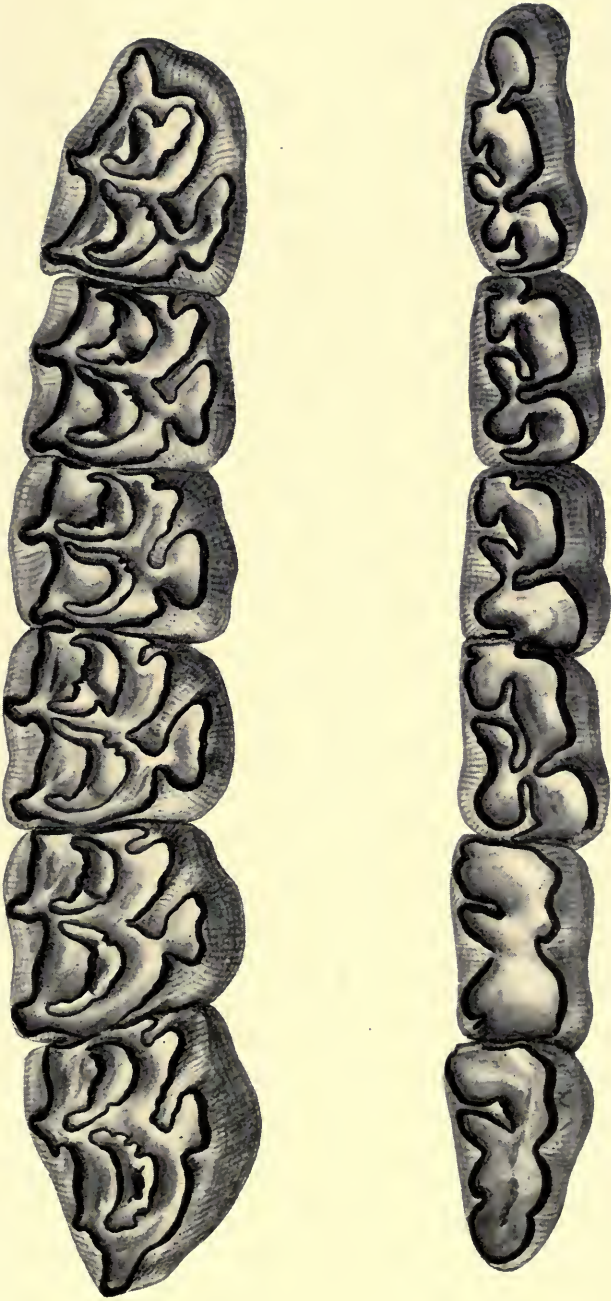


FIG. 19. *Hippotigris simplicidens*. Occlusal views of upper (F.M. No. P14973) and lower (F.M. No. P26163) cheek-teeth. $\times 1$.

The zoological collections of Field Museum contain a rather large series of skulls and jaws of living wild horses including seven *hemionus*, four *grevyi*, sixteen *burchelli*, one *zebra*, seven *asinus* and several *caballus*. I have studied the dentitions of these specimens in detail and have attempted to evaluate the dental characters so far used to distinguish the different horses. The results of this comparison are given below. Some characters that I do not regard as valid might prove to be of value if studied statistically on large numbers of specimens representing a single population. The overlap in most of the characters, however, is so great that a small sample is sufficient for identification only by use of three characters. The differences in the measurable characters analyzed statistically are not significant.

PROBABLY INVALID CHARACTERS USED BY VARIOUS AUTHORS

PROTOCONE.—*More rounded and less elongate in the zebras than in the horses.* There seems to be some tendency for the protocone to be slightly more dilated in the zebras, but the overlap is so complete in the specimens I have seen that I do not regard the character as diagnostic for any particular group.

MESOSTYLE AND PARASTYLE.—*More robust and occasionally doubled in the caballines, less robust and never doubled in the zebras.* This is almost certainly not a dependable character. In many of the zebras in our collection the styles are doubled to a greater extent than in some of our specimens of *Equus caballus* and may be even more robust.

FOSSETTES.—*Vertical crescents interrupted externally by deep regular depressions in the caballines; in the zebras more dilated and rounder and interrupted externally by only a slight convexity.* Although I have found considerable variation in this character there is no correlation between the variations and the different groups.

PLI CABALLIN.—*Present in horses, absent in zebras and asses.* I have found the pli caballin present in some specimens of all species as well as absent in some specimens of all species—an invalid character.

HYPOCONE OF M³.—*Much less developed in the horse than in the zebra, giving M³ of the former a more triangular outline.* There is considerable variation in this character and the variations are shared equally by each of the groups.

EXTERNAL WALLS OF PROTOCONID AND HYPOCONID.—*More flattened in the horses than in the zebras.* This character is certainly not

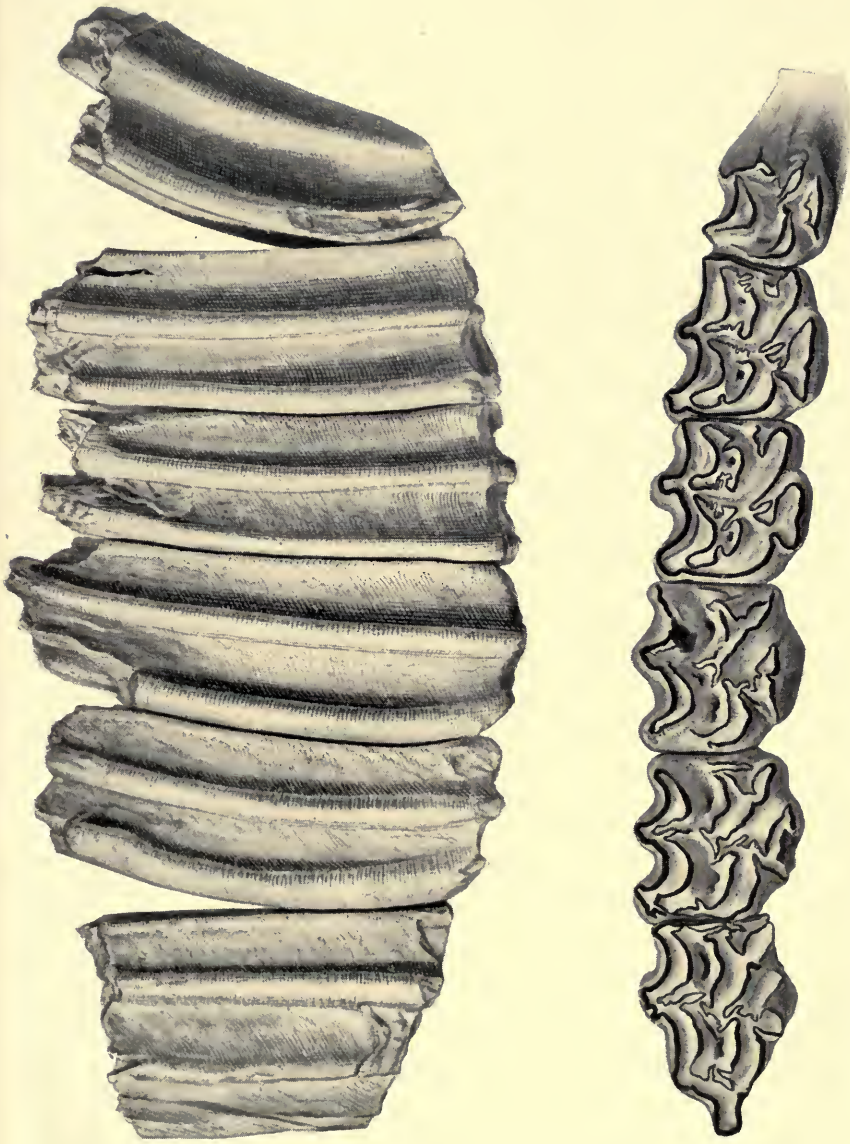


FIG. 20. *Hippopotigris simplicidens*. F.M. No. P14976. Lateral and occlusal views of upper cheekteeth. $\times \frac{2}{3}$.

diagnostic when considering small samples. There is no significant differentiation in the specimens at my disposal.

INCISORS (Stehlin and Graziosi, 1935).—These authors believed that the roots of the incisors were important in separating the African

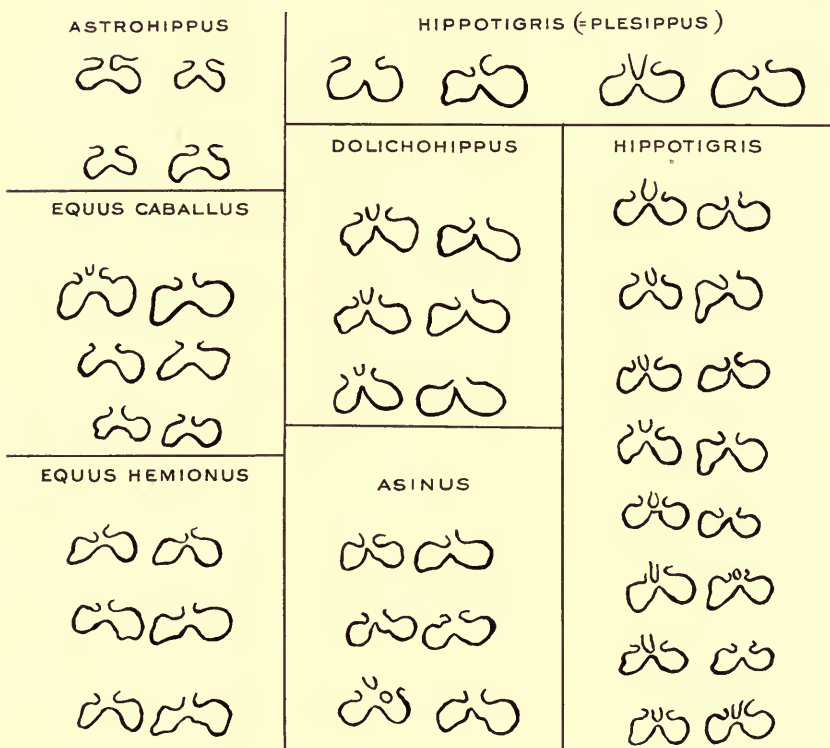


FIG. 21. Metaconid-metastylids of P_4 and M_1 in various equids, showing range of variation in this character in Field Museum specimens.

asses from *Equus hemionus*. In the former the tips of the roots were said to form a rather sharp V whereas in the latter all of the incisors were approximately the same length. In order to check this character Dr. Albert A. Dahlberg, Research Associate in Paleontology, very kindly made radiographs of the incisor region of two specimens each of zebras, African asses, *Equus hemionus*, and *Equus caballus*. Considerable variation was found but no correlation could be established between the variations and the groups. I believe that the character is invalid.

VALID CHARACTERS

METACONID-METASTYLID.—Round, internally convex, and separated by a sharp V-shaped groove in the zebras; more flattened, concave internally, and separated by a U-shaped valley in the caballines. As indicated in the accompanying figures this character appears to be quite dependable in separating the zebras from the caballines. It does not, however, permit distinction between the zebras and African asses. In heavily worn teeth of zebras this character merges into the caballine type and the two groups are more difficult to distinguish. M_3 of the caballines usually assumes the zebrine condition and consequently cannot be used.

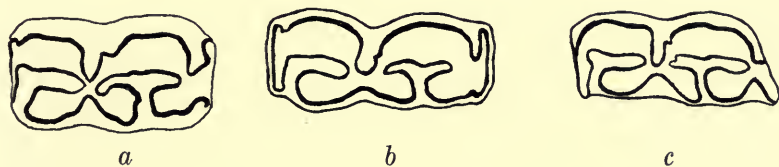


FIG. 22. Left DM_3 of a, *Hippotigris burchelli*, b, *Hippotigris simplicidens*, and c, *Equus caballus*. $\times 1$.

This character appears to be the only one that is really valid in the permanent dentition. In the half-asses (*Equus hemionus*, etc.) the character is more or less intermediate between the horse and the zebra, but closer to the former.

HYPOSTYLID OF DM_3 .—Present, frequently cut off as an isolated lake in the zebras, absent in horses and asses. This is almost certainly a valid character as I find no exceptions among the specimens in Field Museum collections. This character is of particular importance as it clearly separates the zebras and asses, something which cannot be done with permanent teeth.

PARASTYLID (van Hoepen, 1932).—Absent in *Equus caballus* in both milk and permanent cheekteeth; present in both milk and permanent teeth of the zebras, and present but weaker in the asses. As far as I am able to determine, this character is valid only on milk teeth and even then is a little too variable to be dependable. There are two immature specimens of *Asinus* in Field Museum in which the parastylid is essentially absent (represented only by a slight shoulder), and an *Equus caballus* in which it is rather strong near the base of the tooth. There is little doubt that the character has some use in separating the horses from the zebras.

This analysis indicates that it should be possible on fairly limited dental material to distinguish quite definitely between the horses, zebras, and asses. A few permanent lower cheekteeth and a DM_3 should be sufficient. A summary of the valid characters is as follows:

	Metaconid-metastylid	Parastylid of lower milk molars	Hypostylid of DM_3
Zebras	Round, internally convex, V-shaped valley	Strong	Strong
African asses	Round, internally convex, V-shaped valley	Variable	Weak
Caballines	Less round, internally concave, U-shaped valley	Weak	Weak

The zebras, then, are separated from the other equids by exactly those characters by which "*Plesippus*" has been distinguished, and it is consistent with the evidence to suppose that the latter group of forms is ancestral to and inseparable generically from the former. Considering the ranges and the environmental conditions under which the Recent zebrines and caballines occur, some support is found for these relationships. The zebrines disappeared from Europe and America early in the Pleistocene, apparently somewhat earlier in America (see p. 45). In early post-glacial times the zebras existed only in Africa but throughout that continent. The modern zebras are confined to South and East Africa. Horses of the caballine group, on the contrary, seem never to have reached Africa and were in their best environments in the more temperate Holarctica. From the above we might assume that *Hippotigris* was primarily adapted to warm climates. The fact that this form seems not to have reached South America cannot be adequately explained. However, the deep forests of Central America and northern South America may have formed an effective barrier to *Hippotigris* and not to *Equus*. The onset of glacial conditions coincides with the disappearance of *Hippotigris* from North America as might well be expected if the above is true. The caballines which may have been suited to cooler climates were able to populate this continent when *Hippotigris* was no longer able to survive. The chart on page 47 clearly illustrates the southward restriction of the zebrine range.

The nomenclature of the Pleistocene and Recent wild horses is in a very confusing condition. There is no unanimity of opinion regarding the taxonomic status of the different groups. *Hippotigris*, *Dolichohippus*, *Asinus*, and *Equus* are used as full genera, as sub-

genera, and in many cases are not recognized as superspecific groups. The name "*Plesippus*" is equally unstable. Most workers give it full generic rank but some refuse to accept it as more than a primitive member of the genus *Equus*. The observations of J. R. Schultz and those in this study should make it clear that *stenonis* cannot be separated from "*Plesippus*." The same characters with but slight progressive changes appear in *Hippotigris* and it is extremely doubtful if there are any valid means of separating them. Von Reichenau (1915) has already referred *stenonis* to *Hippotigris*. Most authors, however, including some who accord full generic rank to the major living horse groups and who recognize the zebrine characters of *stenonis*, continue to refer this species to *Equus*.

The groups of living horses in general, and the zebras in particular, are subdivided into a large number of species. If the smaller taxonomic units of true horses, half-asses, zebras, and asses are full species, as very few will doubt, certainly the differences between the larger groups are of superspecific importance. If this is admitted, then surely these major groups should be accorded generic status.¹

In order to avoid any possible confusion I have used the term "*Plesippus*" in the early part of this paper. I feel, however, that the continued use of *Plesippus* in a strict taxonomic sense is not warranted because the Blancan horses of America cannot be separated superspecifically from the African *Hippotigris*.

Order Artiodactyla

Family Tagassuidae

Platygonus sp.

Referred specimen.—F.M. P15519, metatarsal IV, lacking the proximal end.

Discussion.—Little can be said of this specimen except that it surely represents the genus *Platygonus*. It is too slender to belong to *Mylohyus* and too large to be *Prosthennops*.

Family Camelidae

Camelops sp.

Referred specimen.—F.M. No. P26397, right M₂.

Discussion.—This specimen is of the same size and form as M₂ of *Camelops* and certainly represents that genus.

¹ The dental characters of *Dolichohippus* are like those of *Hippotigris* and the two are probably more closely related than any other two living horse genera.

Gigantocamelus sp.

Referred specimen.—F.M. No. P26183, distal end of humerus.

Discussion.—This specimen is of such enormous size that it must be referable to *Gigantocamelus* Barbour and Schultz (1939). The possibility that it is *Titanotylopus* (Barbour and Schultz, 1934) is not precluded, but because of the general faunal similarity between the Broadwater and Sand Draw it is most probable that it represents the Broadwater genus. *Titanotylopus* seems to be a later form.

Family Antilocapridae

Capromeryx sp.

Referred specimens.—F.M. No. P26172, astragalus; F.M. No. P15518, calcaneum.

Discussion.—The specimens agree in size and form with *Capromeryx*. The genus is known from the “*Stegomastodon* quarry” (Osborn, 1936), which is apparently equivalent to the Sand Draw (see p. 36). It is also known from Broadwater.

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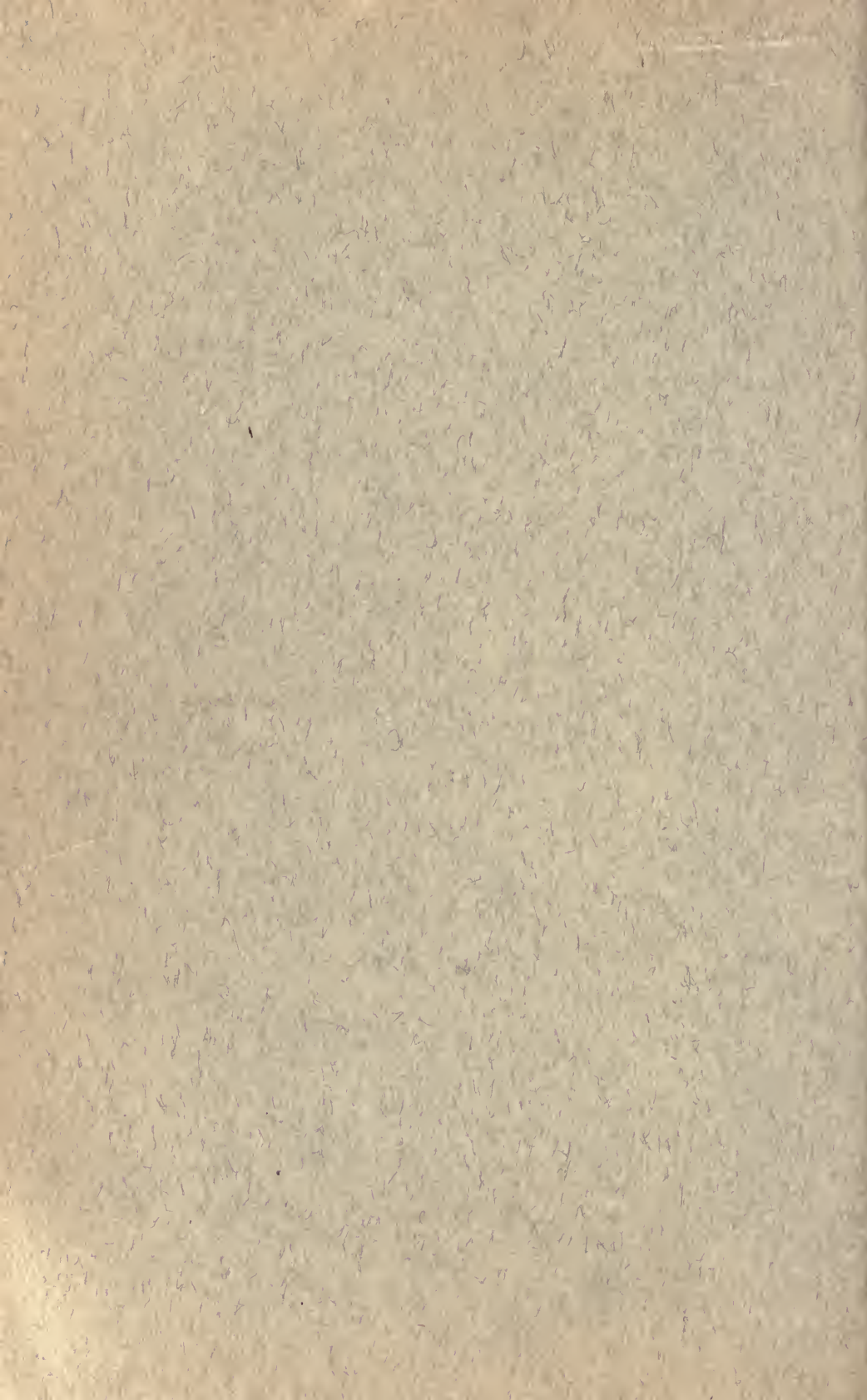
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